CLAIMS

What is claimed is:

1. An excimer or molecular fluorine laser system, comprising:

first and second discharge chambers each being filled with a gas mixture, each of said first and second discharge chambers containing a pair of electrodes for energizing the gas mixture and outputting an optical pulse;

first and second final compression stages in electrical communication with the first and second discharge chambers; and

a common pulser circuit coupled to said first and second final compression stages, the common pulser circuit containing a switch component for sending an electrical pulse to said first and second final compression stages, the common pulser circuit further containing at least one initial compressor stage capable of compressing the electrical pulse, the first final compression stage operable to transmit a first portion of the electrical pulse to said first discharge chamber and the second final compression stage operable to transmit a second portion of the electrical pulse to the second discharge chamber, the receiving of the first and second portions of the main pulse by the first and second discharge chambers causing a timed discharge of the pair of electrodes in each discharge chamber, the first and second discharge chambers being electrically isolated by the first and second final compression stages.

2. A laser system according to claim 1, further comprising:

a power supply for providing a high voltage to the common pulser circuit.

3. A laser system according to claim 2, further comprising:

a storage capacitor for storing the charge from the power supply until the switch of the common pulser circuit sends the charge as the electrical pulse.

4. A laser system according to claim 1, wherein:

the switch of the common pulser circuit is an insulated gate, bi-polar transistor (IGBT).

5. A laser system according to claim 1, wherein:

the first discharge chamber comprises a master oscillator; and

the second discharge chamber comprises a power amplifier, the master oscillator and power amplifier being arranged in a MOPA arrangement such that a light pulse discharged from the master oscillator is received and amplified by the power amplifier.

6. A laser system according to claim 1, further comprising:

a trigger signal generator being capable of providing a trigger signal to the common pulser circuit.

7. A laser system according to claim 6, further comprising:

a processing unit capable of determining a delay between the providing of the trigger signal and a toggling of the switch of the common pulser circuit.

8. A laser system according to claim 7, wherein:

the processing unit is further capable of determining a delay between the providing of the trigger signal and a discharge of each of the first and second discharge chambers.

9. A laser system according to claim 8, further comprising:

a discharge detector for each discharge chamber and in communication with the processing unit for providing a timing of the discharge of each discharge chamber.

10. A laser system according to claim 9, wherein:

the discharge detector is a photodiode capable of detecting the discharge of a light pulse in one of said discharge chambers.

11. A laser system according to claim 9, wherein:

the discharge detector is an electrical sensor capable of detecting the discharge of the pair of electrodes in one of said discharge chambers.

12. A laser system according to claim 1, further comprising:

a reset current unit capable of applying a reset current to the common pulser circuit in order to control at least one of the timing and shape of the electrical pulse.

13. A laser system according to claim 1, further comprising:

a reset current module for each of said first and second final compression stages, each reset current module capable of providing a reset current to adjust the timing of the discharge in the respective discharge chamber.

14. A system according to claim 1, further comprising:

first and second pre-ionization modules in communication with the first and second discharge chambers, respectively, the pre-ionizationionization modules capable of controlling the time at which pre-ionization energy is supplied to said first and second discharge chambers.

15. A system according to claim 14, further comprising:

a pre-ionization circuit in communication with at least one of said first and second discharge chambers.

16. A laser system according to claim 1, further comprising:

a compensation circuit in communication with the common pulser circuit and capable of compensating for time delay jitter between discharges in each of the first and second discharge chambers.

17. A system according to claim 16, wherein:

the compensation circuit provides compensation by adjusting a charging voltage of the common pulser circuit.

18. A system according to claim 16, wherein:

the compensation circuit can control the delay time jitter to sub-nanosecond levels.

19. A system according to claim 16, further comprising:

a feedback loop in communication with the compensation circuit, the feedback loop capable of detecting slow drifts in a time delay between a discharge in the first discharge chamber and the second discharge chamber.

20. A system according to claim 16, further comprising:

a fast analog circuit in communication with the compensation circuit and capable of compensating for fast drifts in a time delay between a discharge in the first discharge chamber and a discharge in the second discharge chamber.

21. A system according to claim 16, further comprising:

a high voltage probe in communication with the compensation circuit, the high voltage probe capable of measuring a charging voltage applied in at least one of said first and second discharge chambers.

22. An excimer or molecular fluorine laser system, comprising:

a master oscillator including therein a first discharge chamber filled with a first gas mixture, the first discharge chamber containing a first plurality of electrodes for energizing the first gas mixture and outputting an optical pulse;

a power amplifier including therein a second discharge chamber filled with a second gas mixture, the second discharge chamber containing a second plurality of electrodes for energizing the second gas mixture, the power amplifier capable of receiving the optical pulse from the master oscillator and amplifying the optical pulse to transmit as an output pulse;

first and second final compression stages in electrical communication with the first and second discharge chambers; and

a common pulser circuit coupled to said first and second final compression stages, the common pulser circuit containing a switch component for sending an electrical pulse to said first and second discharge chambers, the common pulser circuit further containing at least one compressor stage capable of compressing the electrical pulse, the first final compression stage operable to transmit a first portion of the electrical pulse to the first discharge chamber and the second final compression stage operable to transmit a second portion of the electrical pulse to the second discharge chamber.

23. A system according to claim 22, further comprising:

a pre-ionization circuit in communication with the common pulser circuit for controlling a timing of the pre-ionization in each of the master oscillator and power amplifier.

24. A system according to claim 23, further comprising:

a corona discharge component in communication with said pre-ionization circuit and being capable of providing a pre-ionization in at least one of the power amplifier and master oscillator, such that at least one of the first and second gas mixtures can have a determined pre-ionization prior to the arrival of the electrical pulse.

25. A system according to claim 23, wherein:

the timing of the pre-ionization can be controlled separately from the timing of the discharge in at least one of the first and second discharge chambers.

26. A system according to claim 22, wherein:

the common pulser circuit uses a reset current to adjust a nominal delay difference between a discharge of the master oscillator and a corresponding discharge of the power amplifier.

27. A system according to claim 22, further comprising:

a compensation circuit in communication with the common pulser circuit and capable of compensating for time delay jitter in discharges of the first and second discharge chambers.

28. An excimer or molecular fluorine laser system, comprising:

a master oscillator including therein a first discharge chamber filled with a first gas mixture, the first discharge chamber containing a first plurality of electrodes for energizing the first gas mixture and outputting an optical pulse;

a power amplifier including therein a second discharge chamber filled with a second gas mixture, the second discharge chamber containing a plurality of electrodes for energizing the second gas mixture, the power amplifier capable of receiving the optical pulse from the master oscillator and amplifying the optical pulse before transmitting the optical pulse;

a first pulser in communication with the first plurality of electrodes and capable of precisely timing a first discharge in the first discharge chamber;

a second pulser in communication with the second plurality of electrodes and capable of precisely timing a second discharge in the second discharge chamber; and

a common cooling system in thermal contact with the first and second discharge chambers and capable of equalizing the temperatures in each of the first and second discharge chambers.

29. A system according to claim 28, wherein:

each of the first and second discharge chambers is tilted relative to the common cooling system, in order to reduce the spacing between the first and second pluraliy of of electrodes.

30. A system according to claim 28, further comprising:

a feedback loop in communication with the with the first and second pulsers, the feedback loop capable of controlling the timing of the first and second discharges.

31. An excimer or molecular fluorine laser system, comprising:

a master oscillator including therein a first discharge chamber filled with a first gas mixture, the first discharge chamber containing a first pair of electrodes for energizing the first gas mixture and outputting an optical pulse;

a power amplifier including therein a second discharge chamber filled with a second gas mixture, the second discharge chamber containing a second pair of electrodes for energizing the second gas mixture, the power amplifier capable of receiving the optical pulse from the master oscillator and discharging the second pair of electrodes in order to amplify the optical pulse and transmit an output pulse;

first and second final compression stages in electrical communication with the first and second discharge chambers;

a common pulser circuit coupled to said first and second final compression stages, the common pulser circuit containing a switch component for sending an electrical pulse to said first and second discharge chambers, the common pulser circuit further containing at least one compressor stage capable of compressing the electrical pulse, the first final compression stage operable to transmit a first portion of the electrical pulse to the first discharge chamber and the second final compression stage operable to transmit a second portion of the electrical pulse to the second discharge chamber;

first and second discharge detectors, the first discharge detector capable of detecting a discharge in the master oscillator and the second discharge detector capable of detecting a discharge in the power amplifier; and

a processing device capable of receiving a detection signal from each of the first and second discharge detectors, such that the processing device can determine a delay time between the outputting of the optical pulse in the master oscillator and the discharge of the second pair of electrodes in the power amplifier, the processing device being further capable of adjusting the delay time.

32. A system according to claim 31, further comprising:

a pre-ionization circuit in communication with the common pulser circuit for controlling a timing of the pre-ionization in each of the master oscillator and power

amplifier, the processing device being capable of adjusting the delay time by directing the pre-ionization circuit to adjust the timing of the pre-ionization.

33. A system according to claim 31, further comprising:

a reset current unit capable of applying a reset current to the common pulser circuit in order to control at least one of the timing and shape of the electrical pulse, such that the processing device can adjust the delay time by directing the reset current unit to adjust the reset current.

34. A laser system according to claim 31, further comprising:

a first reset current module for said first final compression stage and a second reset current module for said second final compression stage, each reset current module capable of providing a reset current to adjust the timing of the discharge in the respective discharge chamber, such that the processing device can adjust the delay time by directing at least one of the first and second reset current modules to adjust the reset current in the corresponding final compression stage.

35. An excimer or molecular fluorine laser system, comprising:

a master oscillator including therein a first discharge chamber filled with a first gas mixture, the first discharge chamber containing a first pair of electrodes for energizing the first gas mixture and outputting an optical pulse;

a power amplifier including therein a second discharge chamber filled with a second gas mixture, the second discharge chamber containing a second pair of electrodes for energizing the second gas mixture, the power amplifier capable of receiving the optical pulse from the master oscillator and discharging the second pair of electrodes in order to amplify the optical pulse and transmit an output pulse;

a common pulser circuit coupled to a first final compression stage and to a second final compression stage, the common pulser operable to apply an electrical pulse to the first and second final compression stages;

the first final compression stage operable to transmit a first portion of the electrical pulse to the master oscillator;

the second final compression stage operable to transmit a second portion of the electrical pulse to the power amplifier;

a first detector which detects a first time at which a discharge occurs in the master oscillator;

a second detector which detects a second time at which a discharge occurs in the power amplifier; and

a processing device capable of receiving detection signals from each of the first and the second discharge detectors, such that the processing device can determine a delay time between the first time and the second time, and further the processing device is operable to adjust the delay time by adjusting at least one of the following, a first reset current applied to the first compression circuit; a second reset current applied to the second compression circuit, a pre-ionization of the master oscillator, and a pre-ionization of the power amplifier.

36. A method of generating an output beam in an excimer or molecular fluorine laser system, comprising:

generating an optical pulse using a first timed discharge in a master oscillator;

passing the optical pulse through a power amplifier, such that the optical pulse is amplified by a second timed discharge in the power amplifier; and

controlling a timing of the first and second timed discharges using a common pulser circuit, wherein the common pulser circuit contains a switch component for sending an electrical pulse to the master oscillator and power amplifier to trigger each timed discharge, wherein there is at least one compressor stage in the circuit capable of compressing the electrical pulse sent from the switch component, and wherein first and second final compression stages in electrical communication with the common pulser circuit, master oscillator, and power amplifier are capable of compressing a first portion of the electrical pulse being sent to the master oscillator and a second portion of the electrical pulse being sent to the power amplifier while electrically isolating the master oscillator and power amplifier.

37. A method according to claim 36, wherein:

controlling the timing includes controlling a pre-ionization timing in each of the master oscillator and power amplifier.

38. A method according to claim 36, wherein:

controlling the timing includes controlling a reset current in each of the master oscillator and power amplifier.

39. A method according to claim 36, wherein:

controlling the timing includes controlling a reset current in the common pulser circuit.

40. A system according to claim 36, further comprising:

compensating for time delay jitter in the first and second discharges using a compensation circuit in communication with the common pulser circuit.

41. A system according to claim 36, further comprising:

equalizing the temperatures in each of the first and second discharge chambers using a common cooling system in thermal contact with the master oscillator and power amplifier.

42. A method of generating an output beam in an excimer or molecular fluorine laser system, comprising:

receiving a trigger signal to a common pulser circuit, the common pulser circuit including a solid state switch and at least one compressor stage;

toggling the switch of the common pulser circuit in order to generate an electrical pulse;

compressing the electrical pulse using the at least one compressor stage;

directing the voltage pulse to a first final compression stage and a second final compression stage;

outputting an electrical pulse from the first final compression stage to a master oscillator in order to trigger a first discharge and generate an optical pulse, the master oscillator containing a gas mixture and a pair of electrodes for energizing the gas; and

outputting an electrical pulse from the second final compression stage to a power amplifier in order to trigger a second discharge, the power amplifier receiving the optical pulse from the master oscillator such that the second discharge amplifies the optical pulse in order to transmit an output pulse.

43. A method according to claim 42, further comprising:

monitoring a delay time between at least one of the receipt of the trigger signal and the first discharge, the receipt of the trigger signal and the second discharge, and the first and second discharges.

44. A method according to claim 42, further comprising:

controlling a pre-ionization in the master oscillator in order to control a timing of the first discharge.

45. A method according to claim 42, further comprising:

controlling a pre-ionization in the power amplifier in order to control a timing of the second discharge.

46. A method according to claim 42, further comprising:

controlling a reset current supplied to the first final compression stage in order to control a timing of the first discharge.

47. A method according to claim 42, further comprising:

controlling a reset current supplied to the second final compression stage in order to control a timing of the second discharge.

48. A method according to claim 42, further comprising:

monitoring the timing of the first and second discharges.

49. A method according to claim 42, further comprising:

using a processing device to receive information about the timing of the first and second discharges and adjust the timing of subsequent first and second discharges.